INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

FYGL BULLETIN

NO. 2

IFYGL

US IHD
1965 - 1974

ARCH 1972

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

IFYGL BULLETIN No. 2

MARCH 1972

UNITED STATES

DEPARTMENT OF COMMERCE

DEPARTMENT OF DEFENSE

DEPARTMENT OF INTERIOR

DEPARTMENT OF TRANSPORTATION

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL SCIENCE FOUNDATION

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CANADA

ENVIRONMENT CANADA WATER MANAGEMENT AND ATMOSPHERIC ENVIRONMENT SERVICES

DEPARTMENT OF ENERGY, MINES AND RESOURCES

ONTARIO WATER RESOURCES COMMISSION

ONTARIO DEPARTMENT OF LANDS AND FORESTS

Published by the National Oceanic and Atmospheric Administration,
U.S. Department of Commerce, Rockville, Md. 20852

EDITORIAL NOTE

The field operations phase of the International Field Year for the Great Lakes (IFYGL) will begin on April 1, 1972. The IFYGL Bulletin has been designed as a means of reporting on the planning, progress and results of this joint Canadian-United States scientific effort. It will also serve as a vehicle for information exchange among IFYGL participants, as well as others who have an interest in the program and may wish to use IFYGL data. This first issue of the Bulletin gave a preliminary overview of the present status of the organization and planning for the scientific program to be conducted by the United States. IFYGL Bulletin No. 2 provides a similar coverage of Canadian participation. Subsequent issues will review status and results of both the United States and Canadian programs in relation to the Joint (U. S.-Canadian) Technical Plan now under development and will contain contributions both from the U. S. and Canadian participants. As the field operations get underway, announcements of general interest to the scientific community and to those directly engaged in the program will be made, and when data collected during the field operations become available, from individual scientists and IFYGL archives, their existence will be made known. Still later issues will report on experimental results and analyses of individual experiments and projects, both Canadian and United States.

Contributions on all aspects of the IFYGL program are invited from participants in Canada and the United States, including comments and critiques pertinent to plans and to problems encountered as the program enters its active field phase. Such contributions should be sent to:

IFYGL Centre
Canada Centre for Inland Waters
P. O. Box 5050
Burlington, Ontario

or

National Oceanic and Atmospheric Administration
Code EM&P-IFYGL, Room 805, Building 5
6010 Executive Boulevard
Rockville, Md. 20852

CONTENTS

FOREWORD

The IFYGL represents an exciting new opportunity in Great Lakes research. April 1972 to March 1973 will be a year of coordinated intensive observation of all aspects of a large lake (Ontario) and its basin, on a scale not hitherto attempted, directed towards a number of specific objectives related to management of water quality, water quantities, and fisheries resources.

In Canada, federal and provincial agencies and most of the Universities who have been engaged in Great Lakes research over the years will concentrate their field efforts in Lake Ontario during this period. The major U. S. program as outlined in IFYGL Bulletin #1 will be closely meshed with the Canadian program, described in this issue, to provide researchers from many disciplines with a file of reliable synoptic data on a large lake, of unprecedented breadth and depth.

The IFYGL has been many years in the planning. On behalf of Canadian members of the Steering Committee and Management Team, I would like to pay tribute to T. Lloyd Richards of Atmospheric Environment Service, our Chairman, whose wise leadership, quiet diplomacy and unfailing good humour have played a major role in ensuring effective coordinated planning of the Field Year and to Joe MacDowall, Canadian Co-ordinator, who has worked so diligently to pull the various scientific and administrative threads together into the whole cloth of the Canadian contribution to the program. Mr. MacDowall, who is based at the Canadian IFYGL Centre, Canada Centre for Inland Waters, is editor for Canadian material for subsequent bi-national issues of this Bulletin. Anyone wishing to provide news or articles should do so through Mr. MacDowall.

Finally, our thanks to our United States colleagues who have shown great willingness to work out co-operative arrangements, sometimes under difficult constraints. In IFYGL, we are collectively mounting an investigation which will be a scientific landmark. In addition, the spirit of co-operation between countries, governments and universities which is being fostered in IFYGL will, in itself, be an important and, we hope a lasting achievement.

J. P. Bruce,
Director,
Canada Centre for Inland Waters.

CANADA'S APPROACH TO IFYGL

Although the need for a special study of the Great Lakes had occurred to many people, it was Dr. David Anderson of the University of Toronto who, in 1965, proposed the Field Year to the Canadian National Committee for the International Hydrological Decade (IHD). He suggested that this effort should be devoted to a single basin, rather than dispersed over all the Great Lakes, that it should be carried out jointly with the United States, and that it should be a synchronized, multi-disciplinary study. The Lake Ontario basin was then chosen.

The Canadian National Committee for the IHD agreed that the proposal fitted well into their 10-year program (a program initiated by the United Nations Educational, Scientific and Cultural Organization). They invited Canadian agencies with interests in the lake and its environment to deploy their efforts for the Field Year as part of their ongoing programs. An International Steering Committee was established and the process of developing scientific programs began. These were extended to include the biology as well as the hydrology of Lake Ontario (see "The Scientific Programs").

The objectives of the IFYGL, established jointly with the U. S. A., are to understand the Lake Ontario drainage basin well enough to ensure that its waters will always be sufficient in quantity and of good quality, and assist operations that are affected by environmental conditions.

The period of intensive field activity will be from April 1, 1972, to March 31, 1973. This is to be followed by the data organizing and reporting phase, which will run to the end of 1974. Once the data have been put into usable form, they will be an asset to water resource management and research for decades to come.

On the Canadian side, authority and responsibility for many land and water use decisions rest with the Province of Ontario.
For a speedy and effective approach to the problems, both federal

and provincial agencies have been involved in all phases of the Field Year from the outset. This partnership is reflected in the make-up of the Steering and Management Committee:

T. L. Richards (Chairman)	Atmospheric Environment Service, Environment Canada;
J. P. Bruce	Canada Centre for Inland Waters, Environment Canada;
W. J. Christie	Glenora Fisheries Station, Ontario Department of Lands & Forests, and International Biological Program Observer;
A. K. Watt	Ontario Water Resources Commission, Toronto;
D. F. Witherspoon	Great Lakes - St. Lawrence Study Office, Environment Canada;

I. C. Brown, Secretary, Canadian National Committee, IHD, is an ex officio member of the Steering Committee;

J. MacDowall, O. B. E., Canadian Co-ordinator, International Field Year for the Great Lakes, is located at the Canada Centre for Inland Waters, Burlington, Ontario.

CANADIAN AGENCIES

The federal-provincial partnership extends into the scientific programs and projects, which involve the Ontario Department of Lands and Forests, the Ontario Water Resources Commission, Environment Canada, and the federal Department of Energy, Mines and Resources. From the inception of the Field Year, a number of Ontario universities, too, have been active in program development, and they are undertaking several of the research projects. The government agencies and the laboratories through which they operate are given in Table 1.

Table 1. Government laboratories responsible for Canadian projects

Agency	Laboratory Locations	Abbreviation
Environment Canada	Atmospheric Environment Service, Toronto, Ontario	(AES)
	Atlantic Oceanographic Laboratory, Dartmouth, Nova Scotia	(AOL)
	Canada Centre for Inland Waters, Burlington, Ontario	(CCIW)
	Canadian Wildlife Service, Ottawa, Ontario	(CWS)
	Great Lakes - St. Lawrence Study Office, Cornwall, Ontario	(GLSL)
	Hydrologic Sciences Division, Inland Waters Branch, Ottawa, Ontario and Calgary, Alberta	(HS)
	Marine Sciences, Ottawa and Burlington, Ontario	(MS)
	Water Survey of Canada, Guelph, Ontario	(WSC)
Dept. of Energy, Mines & Resources	Canada Centre for Remote Sensing, Ottawa, Ontario	(CCRS)
	Earth Physics, Ottawa, Ontario	(EP)
	Geological Survey of Canada, Ottawa, Ontario	(GSC)

Table 1. (Concluded)

Agency	Laboratory Locations	Abbreviation
National Museum of Canada	Ottawa, Ontario	(NM)
Ontario Water Resources Commission	Toronto, Ontario	(OWRC)
Ontario Department of Lands & Forests	Picton and Wheatley, Ontario	(ODLF)

WHY LAKE ONTARIO WAS CHOSEN

Although the Field Year studies will concentrate on the Lake Ontario basin, they are so structured that most of what is learned will apply also to the Upper Lakes. Lake Ontario is well suited to this special treatment because:

- it is typical of the Great Lakes (excluding Lake Erie);
- a lot needs to be learned about the lake and the impact of the basin;
- it is conveniently located and thus can be studied at a reasonable cost;
- significant deterioration of Lake Ontario water quality has taken place so that the need for basin management is urgent. The Canadian side is now one of the most rapidly developing regions in North America in terms of urban and industrial per capita investment and population growth. Lake Ontario receives heavy pollution loads from the United States side and from the Niagara River as well as from Canadian sources.

As the Lake Ontario basin is shared by the United States and Canada, the Field Year is a joint effort. This is because any decision or action that affects land use in the basin and the shoreline, including sewage treatment, has an effect on the whole lake. Rapid urban and industrial developments that are occurring result in an ever-increasing impact on the lake. This impact makes it essential to study the whole watershed, of which the lake is just under 25% of the total area.

Canada's particular interest is evident from the fact that the western end of the basin contains 25 per cent of the nation's population and a heavy concentration of its industrial-commercial wealth and power. The lake is also the source of the St. Lawrence River, along whose banks reside another major portion of Canadian population and where many industries are located.

MANAGEMENT PROBLEMS IN THE LAKE ONTARIO BASIN

The International Field Year for the Great Lakes is based on six scientific programs, to which Canada is contributing some 90 projects under the leadership of about 50 principal investigators. The aim is to find solutions to problems, rather than to increase scientific knowledge for its own sake. The major problems and the scientific programs most closely related to them are summarized below.

Pollution Control

Sewage systems, surface water, land erosion and precipitation deposit phosphates, other nutrients and toxic substances in the water; their disposal depends on the life and chemical processes of the lake. The Water Movement program will deal with the rate of dispersal of waste materials through circulation and diffusion. The Biology-Chemistry program will measure the input of these materials and their fate in the lake, and the resulting chemical budget will lead to a more accurate assessment of the inflows of nutrients and toxic substances. It will also show the extent to which phosphates have increased or decreased since the International Joint Commission study made five years ago and the rate at which additional control measures are needed to preserve water quality to meet the future needs of the population and its associated industries.

Thermal-Electric Generating and Other Plants

The water discharged into the lake from nuclear power plants is a source of heat and of some radio-active isotopes. Fossil fuelled and some industrial plants also contribute some heat. The Energy Balance and Boundary Layer programs include investigations of the heat discharged into the water and the air above it. Increased knowledge of the lake's natural energy budget is also needed in order to assess the impact of man's activities which add to that budget. The Biology-Chemistry program will, as well, provide some insight into the problems which could arise; from the concentration, by movement through the food chains, of infinitesimal amounts of radio-active isotopes; or from the stimulation of algae growth. The Lake Meteorology program will help assess the likely effects on local climate.

Improved Weather Forecasts

The type and distribution of weather in the basin is greatly influenced by the lake. Greater knowledge of this influence, leading to a better understanding of fog, snow patterns and shower suppression, will come through the Lake Meteorology program. Shipping and boating will benefit from accurate local weather forecasting. The lake is also viewed as a laboratory-sized ocean in order to study air-water relationships important to the improvement of long-range weather forecasts.

Water Supply

The demand for water is not great enough to deplete the overall supply seriously, but some local shortages and quality problems occur in the Lake Ontario basin. Therefore, much more has to be known about the quantity and quality of water available from the lake, and the intake locations that would provide the best water. The Water Movement and Terrestrial Water Budget programs will help to provide the answers. The Biology-Chemistry program will give information about eutrophication trends and so help predict how long a particular intake can continue to provide clean and filterable water.

Groundwater

At present, the purest, extensive source of potable water is groundwater. Many people living in the basin depend on this supply. Hydro-geological aspects of the Terrestrial Water Budget program will give essential information on quantities of groundwater available for use within the basin.

Lake Levels

Hydro-electrical plants on the St. Lawrence River are major users of lake water. The amount of water released from the lake at Cornwall, Ont., and hence the appropriate outflows, are determined weekly under an international agreement with the U. S. A.. The aim is to meet the demand without adversely affecting lake levels for such purposes as navigation, recreation, etc.. The volume of the lake water can be readily found, but much less is known about the basin, which is over three times the area of the lake, and thus serves as an important catchment area for the lake. Projects within the Terrestrial Water Budget and Lake Meteorology and Evaporation programs are intended to remedy the lack of data.

Fisheries, Aquaculture and Fish Stocks

Lake Ontario fish stocks are badly depleted so that commercial fishing is on the verge of collapse. The combined effects of population growth and

the extent of urbanization is greatly increasing the demand for sport fishing. The management and development of fishing will be aided by research in the Water Movement program, by water temperature data from the Energy Balance program, and by information on the introduction of new fish species and the control of pests (lampreys) under the Biology-Chemistry program.

The International Field Year for the Great Lakes consists of six scientific programs, which are based on the research needs established by joint working groups from Canada and the United States. The programs, all related to problems on the Great Lakes, are directed by panels, each with co-chairmen from the two countries. The programs and the Canadian co-chairmen of the panels are:

Biology and Chemistry:	W. J. Christie, Glenora Fisheries Station, Ontario Dept. of Lands & Forests.
Boundary Layer:	F. C. Elder, Canada Centre for Inland Waters, Environment Canada.
Energy Balance:	G. K. Rodgers, Great Lakes Institute, University of Toronto.
	F. M. Boyce, Canada Centre for Inland Waters, Environment Canada.
Lake Meteorology:	J. A. W. McCulloch, Atmospheric Environment Service, Environment Canada.
Terrestrial Water Budget:	D. F. Witherspoon, Great Lakes-St. Lawrence Study Office, Environment Canada.
Water Movement:	E. B. Bennett, Canada Centre for Inland Waters, Environment Canada.

Summaries of the main features of the Canadian scientific programs follow. A list of projects together with project leader and laboratory

responsible will be found in Appendix 1.

Biology-Chemistry

Practical management of the lake requires an understanding of its many interlocking processes, which vary with the seasons and bring about changes in the chemical, biological and physical state of the lake and its basin.

One of the main priorities in this program is to study the materials entering the lake from 47 tributaries, 34 sewage plants, 29 industries, and rain inputs and, in particular, to measure the amounts of algae-producing nutrients in these materials. The state of the plankton will also be given special attention.

The Canadian program will concentrate on observing and understanding the biological-chemical processes at selected times and stations, in conjunction with the U. S. lake-wide program of research, including monitor and research cruises, and both ground and airborne surveys.

Fish are important in the program, not only because of the need to develop the fishing potential, but also because their health and survival indicate the condition of the lake. They play a part, too, in the recycling and movement of pollutants. An international study, based on the netting of fish, will cover their distribution, stocks, condition and spawning, and also the food chains on which they depend. Vital information is obtained from a study of fish feeding habits on how nutrients and toxic (including radioactive isotopes) material is cycled and concentrated.

Boundary Layer

The boundary layer refers to the air adjacent to the earth's surface; this layer is greatly influenced by the characteristics of the lake, local geography and land use.

Much of the effort in this program will go into measuring the surface-movements of heat, water vapour and elements that are present in the air, and into understanding the response of the boundary layer to the surface at various seasons. Useful information will be assembled on winds, temperature, humidity and air pollution, all of which are influenced by the lake, and have obvious direct effects on the lake and on the lives of the people within its basin.

This program calls for the use of aircraft, rockets and balloons at representative periods from April to November, and buoys and lake towers throughout those seven months.

Lake Energy Balance

This program is directed to the thermal structure of the lake and to the energy budget, or the quantities of heat gained, lost or held by the lake, which serves as a kind of heat reservoir.

The major research tasks include the study of radiation exchange, evaporation, ice and snow, heat content, heat balance and structure. Knowledge of the thermal structure matters a great deal because it affects water circulation and dispersion, ice formation and distribution, the lake's capacity for dealing with pollution (especially in the form of heat discharge), wildlife habitats, recreational potential and the local climate.

Researchers will use three or four ships in monitoring the stored energy in the lake during cruises at intervals of one to two weeks. They also have stations for observing radiation, heat inputs from rivers and the atmosphere, ice conditions, surface temperatures, precipitation and terrestrial heat flows.

Lake Meteorology and Evaporation

There are two aspects to the meteorological program; Lake Ontario is sufficiently large to affect the local weather significantly, but it is also large enough to be regarded as a model ocean for studying the interactions of air and water. In addition, evaporation is to be given special attention.

The main thrust of the meteorological research will be a detailed study of changes in the atmosphere as it passes over the lake. Other studies will be concerned with precipitation, wind and pressure over land and lake. Some studies have indicated that atmospheric conditions are predictable for a period of one to three weeks when data are available for oceans, and provided that the physical process involving atmosphere and ocean can be understood.

Evaporation from the lake's surface will be measured by at least five methods: the energy, water and atmospheric budgets, and also aerodynamic and eddy flux techniques.

All of this requires a complex network of stations, buoys, radar and aircraft. The results should lead to improved local and long-range weather forecasting.

Terrestrial Water Budget

The terrestrial water budget is an accounting of the sources, storage and movement of water between the atmosphere, the land and the lake. An

immediate aim is to improve methods of measuring the inflow from the Niagara River and the outflow into the St. Lawrence. There are at present considerable gaps in knowledge of the lake and land water budget, especially with respect to evaporation from the lake and soil moisture and groundwater storage in the land. Geological studies within this program, which are directed towards the water-bearing qualities of the rocks and overburden, will be of great importance in view of the utility of groundwater supplies. Remote sensing from high-altitude flights will detect soil moisture, which, apart from its significance to agriculture, is an indication of geological structure and of the location of springs as groundwater outflows in the water balance.

The main aspects of the program relate to the lake water budget, inflow, groundwater, lake levels, geology and land water balance. Particularly helpful will be the several independent measurements of evaporation which will be made by the Lake Meteorology, Energy Balance and Boundary Layer programs.

The hydrometric network, which is being used to measure the flows and levels of small lakes and rivers, consists of 124 stations on the Canadian side of the basin.

Water Movement

These studies are an attempt to define water circulation and diffusion within a large lake, and they will provide information on water motion and its peculiarities in Lake Ontario. Dyes are commonly used to study the diffusion characteristics of water, and drogues and instrumented buoys to measure water circulation; the results are correlated with weather conditions. Another aspect of water motion, the internal and surface waves, require instrumented buoys and arrays of gauges for their observation. The effects of lake levels, winds and pressures are taken into account.

The movement and dispersal of water in the lake are of special interest because they distribute the waste materials that enter the lake from sewage plants, industry, runoff and streams. The intensity of this diffusion also controls the rate at which plankton and algae can grow.

Meteorological Buoys

The meteorological buoys will be installed at the positions given in Figure 1 by the Limnos (buoys 1 - 6) and the Martin Karlsen (buoys 7 - 11) between March 27 and 30. Meteorological instrumentation will be established by the Lac Erie April 4 - 7 (buoys 1 - 6) and April 17 - 20 (buoys 7 - 11). There is no meteorological buoy on 4, instead a meteorological buoy alone will be located nearby at station 4a in the vicinity of the micrometeorology site.

The buoys will then be serviced regularly by the Lac Erie (see schedule in Figure 13) until they are finally collected by the Limnos December 7 - 9 and December 14 - 15.

Temperature Survey

The temperature survey will be carried out throughout the Field Year by two ships, the Limnos and Porte Dauphine, simultaneously cruising on an interweaving pattern. The cruise tracks and station locations for the two ships are given in Figures 2 and 3 and the dates of the cruises in Figures 10 and 11.

The Martin Karlsen will replace the Limnos and assist the Porte Dauphine for the January 2 - 4 winter cruise.

Organic Particle Study (OOPS)

Each set of two one-week cruises is divided into two phases:

(1) Phase 1 will be carried out in Week 1 and will cover 32 stations. (See Figure 4) This includes a master station at station 32.

(2) Phase 2 will be carried out in Week 2 and will cover 2 master stations. (See Figure 5) Station 1 corresponds to station 11, Phase 1 and station 2 corresponds to station 19, Phase 1.

The Martin Karlsen will be responsible for all nine cruises (see schedule in Figure 12 for dates of cruises).

Current Meter Moorings

The deep water current meter moorings will be established at the positions given in Figure 1 (except for positions 1, 4a, 5, 7) by the Limnos between May 15 and 20. The flag stations and current meters of the coastal chains will also be established by the Limnos at a later date (May 23 - 26). See Figures 7 and 8 for coastal chain station positions. The moorings will be refurbished by the Limnos according to the schedule in Figure 10 and finally removed October 10 - 14.

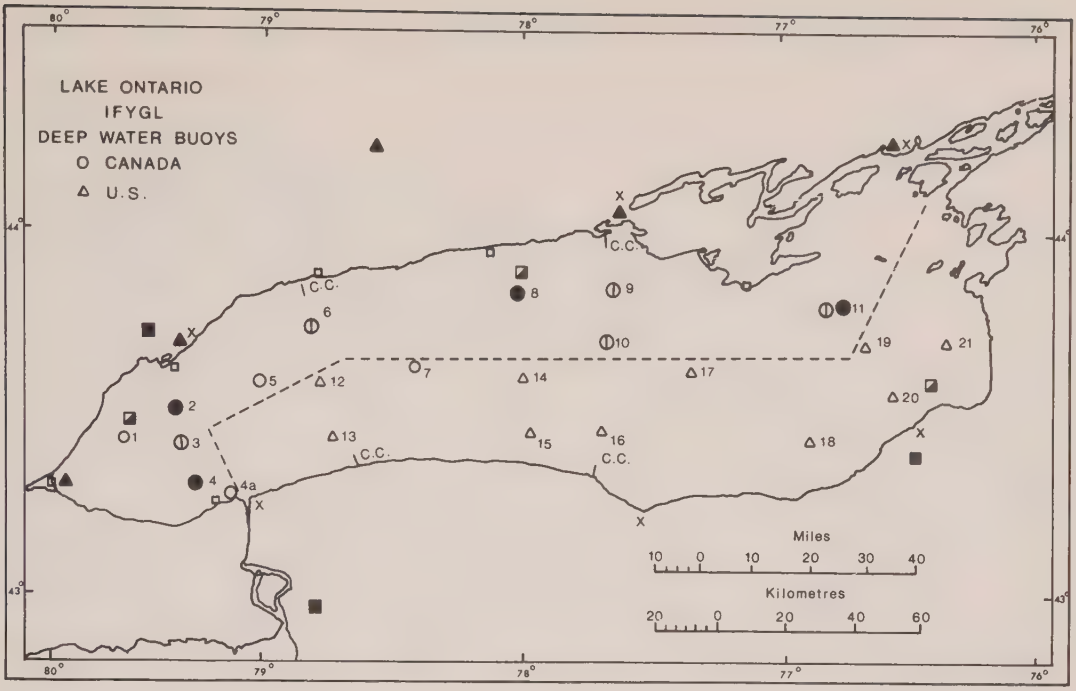

Figure 1. Positions of meteorological buoy and current meter moorings. ⦶ thermistor chain; $\overline{c.\ c.}$ coastal chain; ● wave mooring; □ shoreline station; ■ radar; X evaporation pans; ▲ global solar and downward total radiation; ◪ Bedford buoys.

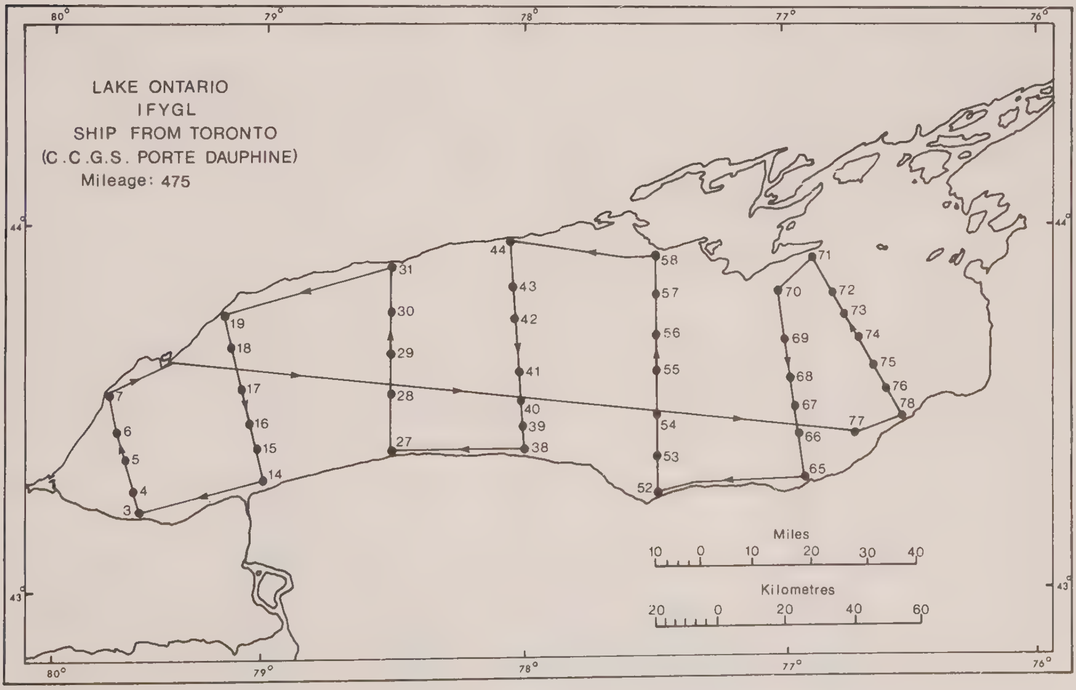

Figure 2. Cruise track and station locations for half of temperature survey. See Figure 3 for other half.

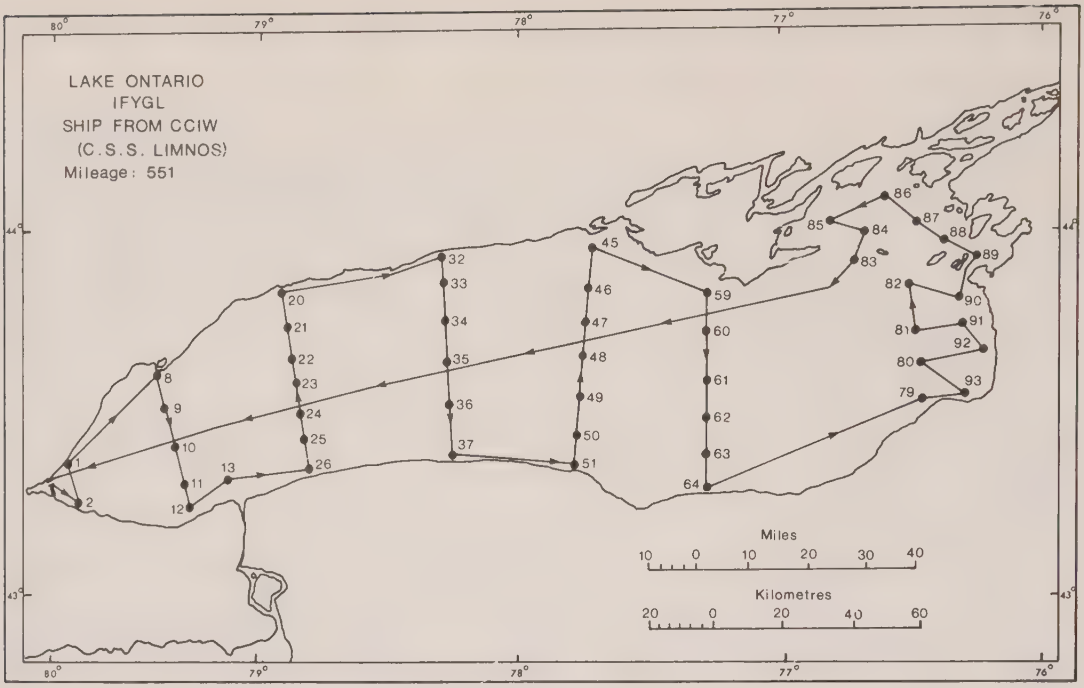

Figure 3. Cruise track and station locations for half of temperature survey. See Figure 2 for other half.

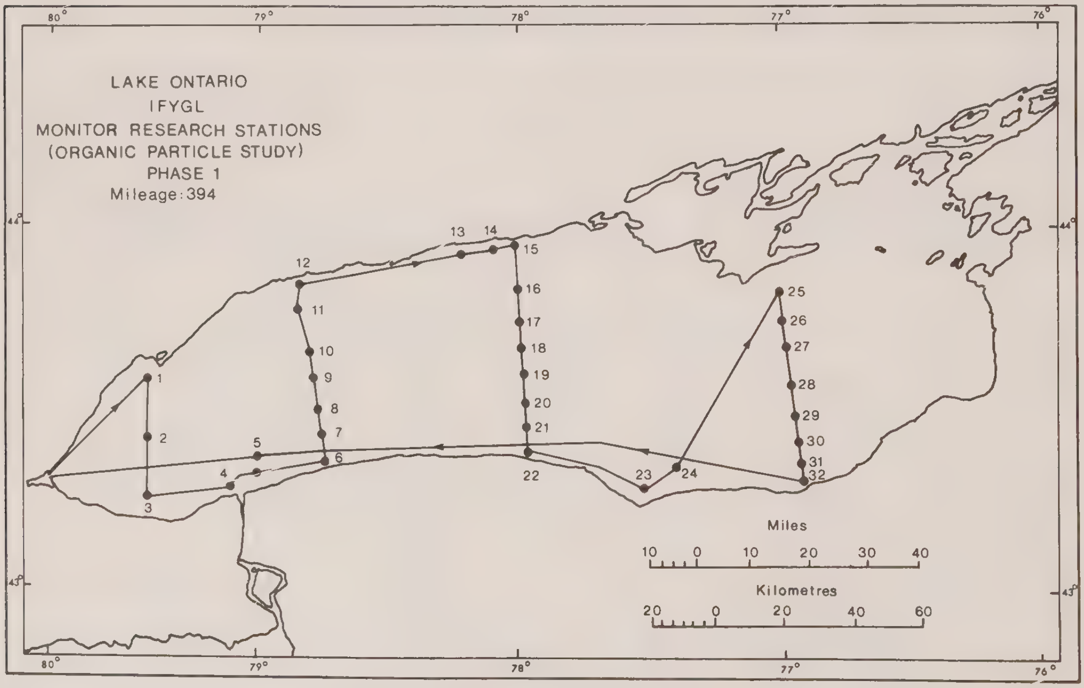

Figure 4. Cruise track and station locations for Phase 1 of organic particle study cruises.

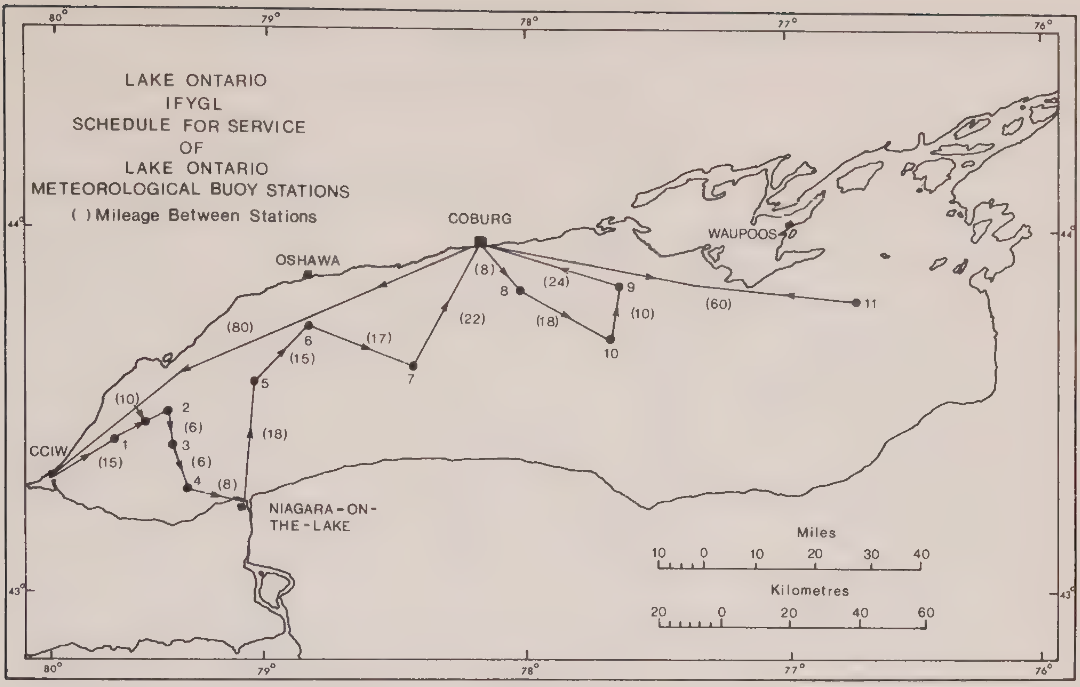

Figure 5. Cruise track and station locations for Phase 2 of organic particle study cruises.

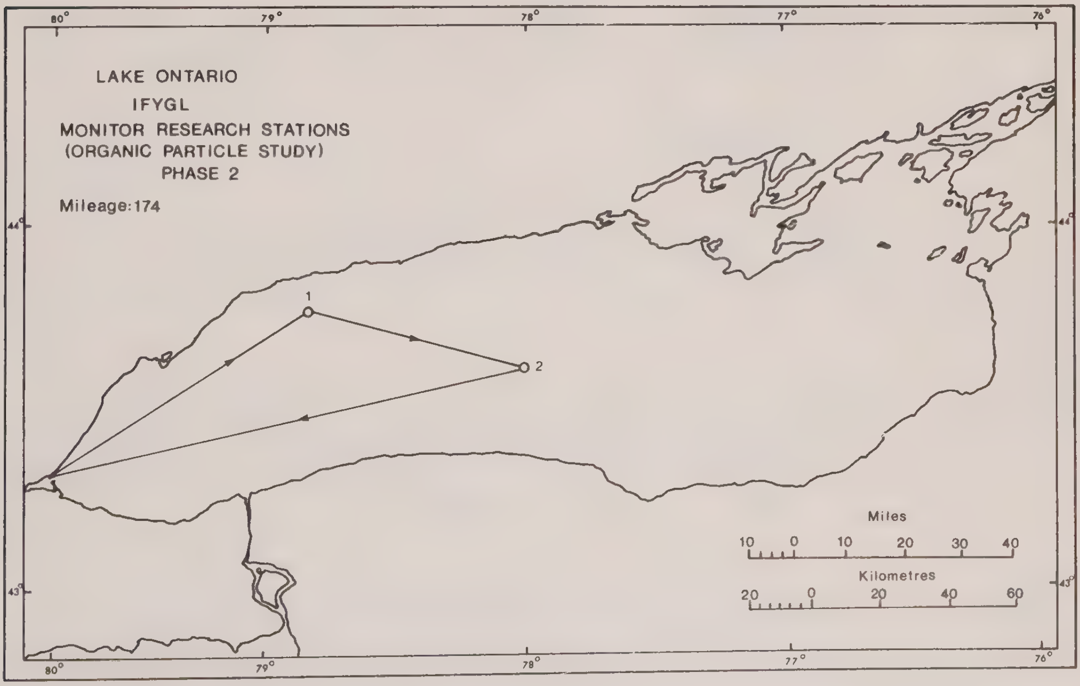

Figure 6. Cruise track for servicing of meteorological buoys.

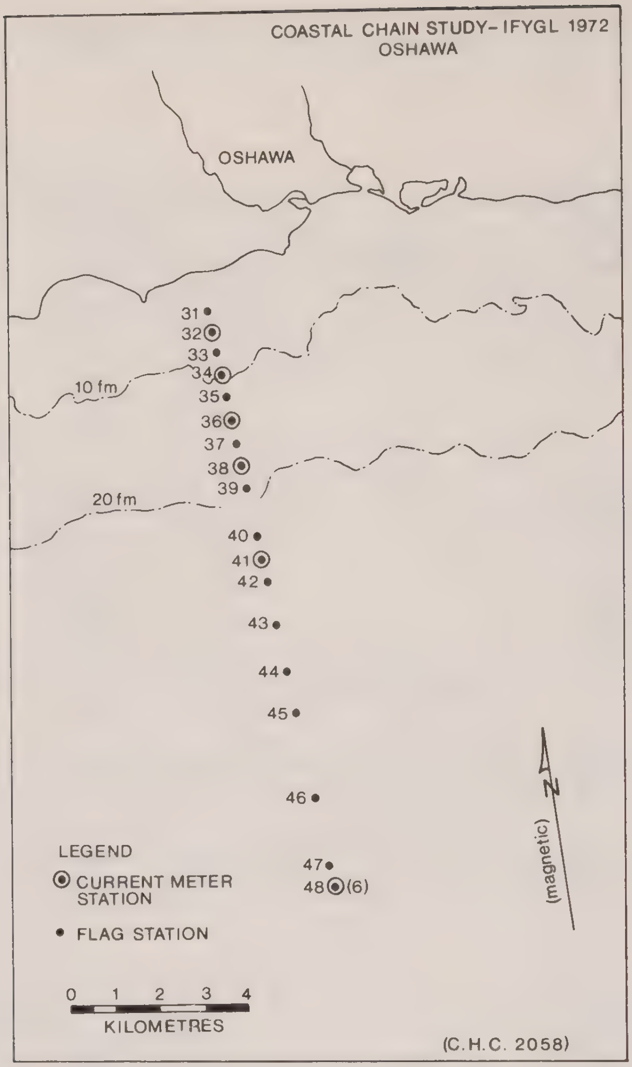

Figure 7. Coastal chain station positions off Oshawa.

Monitor Cruises

Two physical, chemical and biological monitor cruises covering 95 stations each will be carried out by the Martin Karlsen (see schedule for dates) following the track plot given in Figure 9.

Decca Buoys

Decca navigator buoys will be moored by the Martin Karlsen between March 13 and 17 and between March 20 and 24. During the same period they will be made operational by the Limnos, who will also calibrate and establish reference buoys.

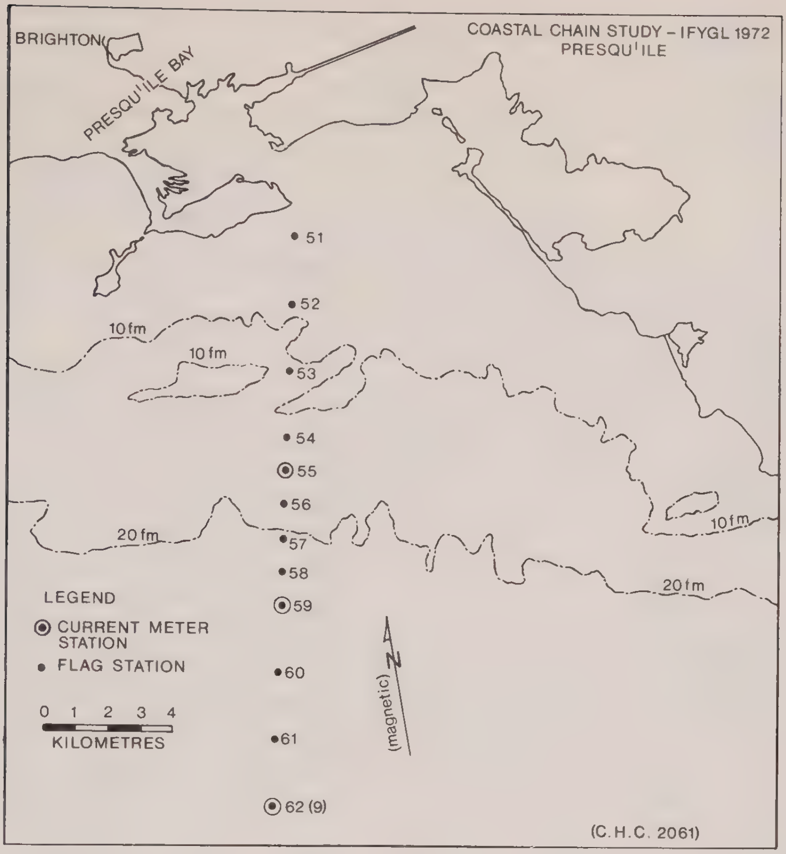

Figure 8. Coastal chain station positions off Presqu'ile.

Boundary Layer

The Lac Erie will be used to tow the barge Handy Boy to the Niagara area May 1 - 2 and to tow it back to CCIW November 4. It will also be available in September (see schedule in Figure 13) to assist in Niagara bar studies.

The launch Agile will also participate in the boundary layer study and will be used May 1 - 13, June 5 - 24, August 13 - 26 and October 1 - 14.

Other Launch Support

(a) The remote sensing program, carried out in the Oshawa area, will be assisted by the launch Sturdy during the periods May 1 - 20, July 4 - 15 and September 25 - October 7.

(b) The Bedford Tower near Oakville will be serviced every 7 - 10 days by the launch Bruce between June 1 and October 27.

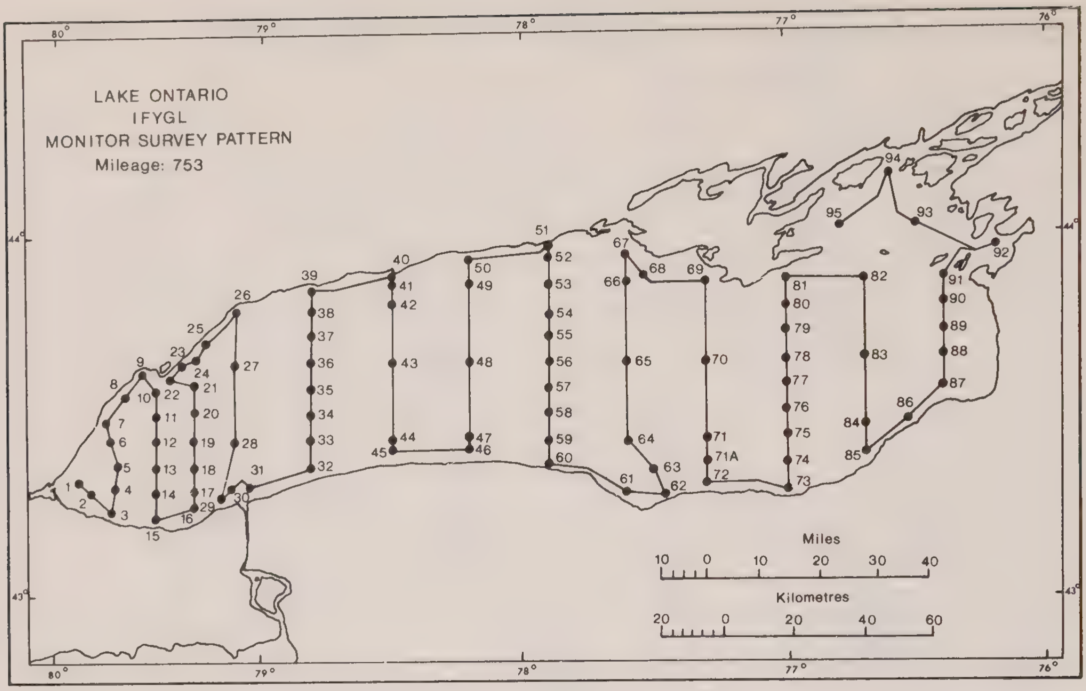

Figure 9. Cruise track and station locations for monitor cruises.

Dye Diffusion Studies

There will be seven dye diffusion cruises carried out by the Limnos (see Figure 10 for dates) at the positions 43° 39' 30" N, 77° 42' 36" W and 43° 56' 54" N, 77° 40' 54" W near the Presqu'ile coastal chain. The Limnos will be assisted by the launches Aqua and Lemoyne (May 1 - October 27) and the launch Sturdy (to be used May 23 - June 30, July 18 - September 23, October 10 - 27).

Temperature Transect

Temperature profiles will be carried out by the Limnos on a line running from Oshawa, Ontario, to Olcott, N. Y., according to the schedule in Figure 10.

Bathymetric Survey

A bathymetric survey of the Lake will be carried out by the Limnos during the Field Year (see schedule in Figure 10 for dates of cruises).

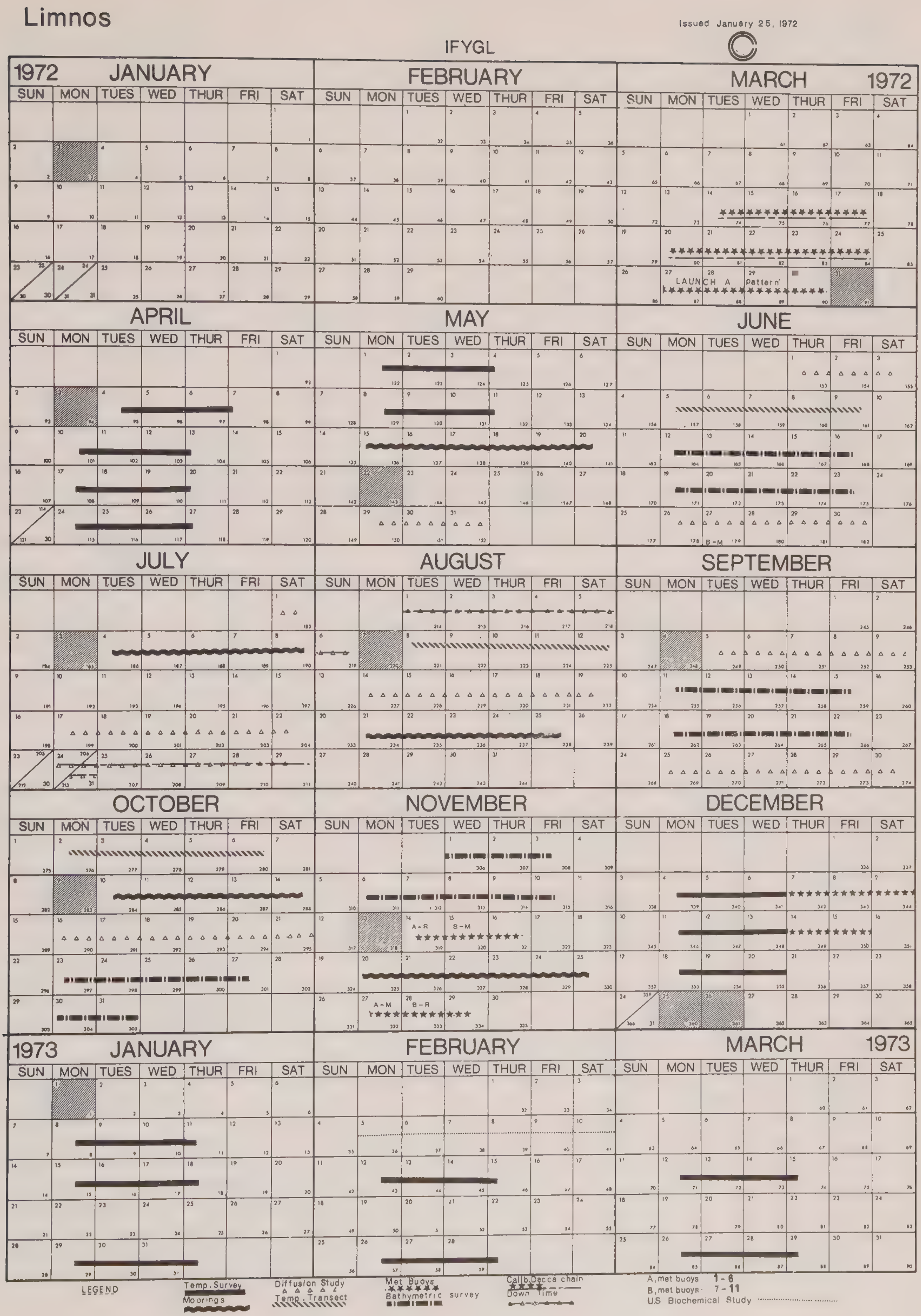

Figure 10. Field Year cruise schedule for the CSS Limnos.

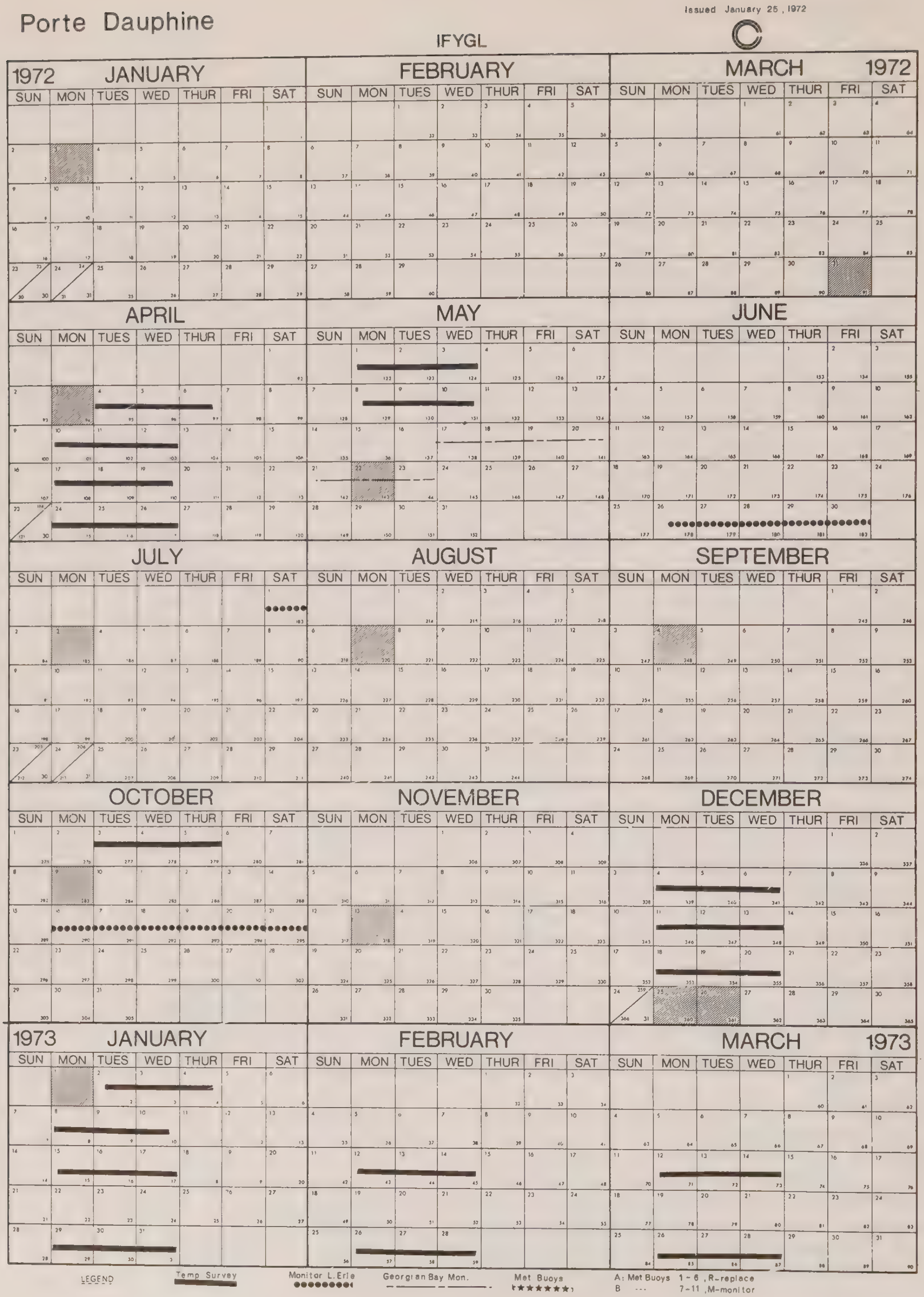

Figure 11. Field Year cruise schedule for the CCGS Porte Dauphine.

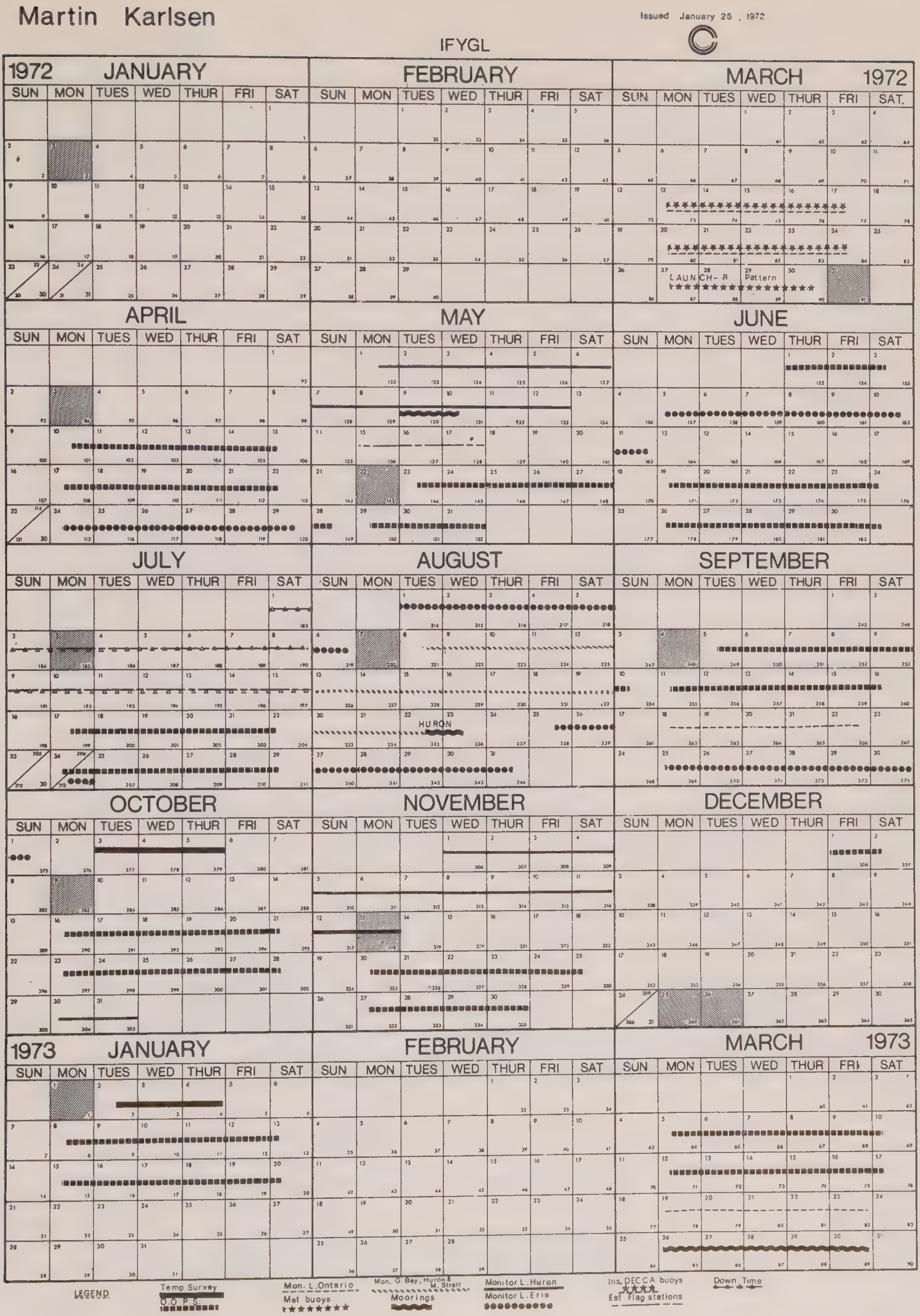

Figure 12. Field Year cruise schedule for the MV Martin Karlsen.

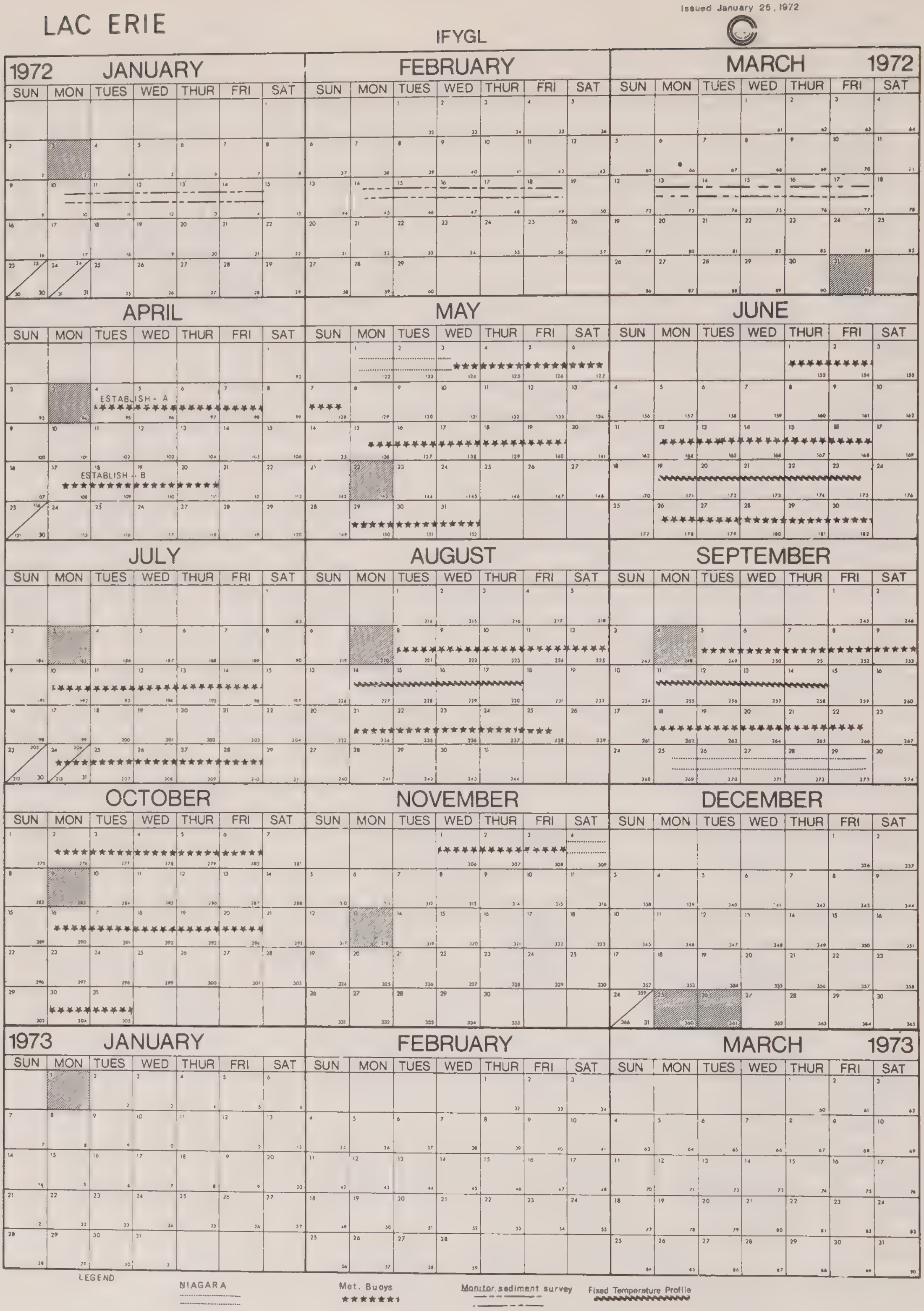

Figure 13. Field Year cruise schedule for the MV Lac Erie.

FACILITIES AND SUPPORT SERVICES

The facilities committed to the Canadian aspects of the International Field Year for the Great Lakes give an idea of the importance and complexity of this operation. The inventory and the agencies supplying these items are given in Table 2.

Table 2. List of facilities for IFYGL

Facility	Laboratory
3 major research vessels --	
CCGS Porte Dauphine	AES/CCIW/U. of T.
CSS Limnos (see Figure 14)	CCIW/MSB
MV Martin Karlsen (see Figure 15)	CCIW/MSB
1 buoy tender and small launches	CCIW/MSB
2 research vessels (Cottus and Keenosay)	ODLF
11 meteorological buoys	CCIW
8 current-measuring buoys, 4 equipped with thermistor chains	CCIW
3 deep water towers with profile-measuring equipment for atmospheric and boundary layer studies	AES
3 micrometeorological towers with servicing barge and small launch	CCIW
3 land stations and ship-board equipment for Position Fixing System	MS/CCIW
6 automated shoreline stations	AES
3 upper-air rawinsonde stations	AES
1 radar station and computer data integrator for precipitation studies	AES
1 twin-engined aircraft for weekly reconnaissance flights (ice observer in season)	AES
1 airborne infrared scanner	CCIW

Facility	Laboratory
1 T-33 aircraft for flux measurements and atmospheric research studies	NRCC/NAE
1 small aircraft for flux measurements	HS
enhanced meteorological networks in the basin	AES

Publications

There are two main groupings of publications: project reports and IFYGL Publications. Project reports are all papers relating to approved IFYGL projects and should be published through normal channels for publishing research, giving appropriate acknowledgment to the IFYGL involvement.

The IFYGL publications will include: a Technical Plan, giving the overall program, its development and a list of data expected to be collected; a Scientific Series, with one or more volumes describing each program; a Data Index; and three Technical Manuals.

Canada is responsible for the publication of the Technical Manuals. The first, on Soil Moisture Measurement, has been published; the second, on Radiation Measurement is at the press; and the third, on Near-Shore Current Measurements is in the reviewing stage.

A series of lists of abstracts of all IFYGL publications as well as all papers of interest to IFYGL participants has been prepared by the Canadian Coordinator and will continue to be produced as more information becomes available. Future lists will also include abstracts of approved project reports as they are published. The first five lists together with an author index for Lists 1 - 4 have been prepared and are available from:

J. MacDowall,
Canadian Coordinator, IFYGL,
Canada Centre for Inland Waters,
P. O. Box 5050,
Burlington, Ontario.

Editorial Committee Function

The IFYGL Editorial Committee, consisting of the two Co-chairmen, the two IFYGL Coordinators and the two IHD National Secretaries, will be responsible for:

(1) Administrative review and approval of project reports (necessary to insure recognition of reports in IFYGL publications).

(2) Arranging for writing, editing, and publishing of only the IFYGL Publications decided on by the Steering Committee.

Figure 14. The CSS Limnos was specially designed for limnological research; she is 147 ft. long with a displacement of 610 tons.

Data Management

Field Year data collected in Canada will be stored in the Canada Data Bank located at the Canada Centre for Inland Waters, Burlington, Ontario.

The data from IFYGL will be stored in three levels. The third level will be the observational data collected by the agencies, translated, checked and verified, and then submitted to the bank. In some cases, raw data will also be stored if there is no guarantee of retention by the investigator and it is relevant to future users.

The second level of data storage will be in a summarized form. This level of data was developed to provide a compact, readily accessible data bank which will be cheap to obtain, easy to use and transport, and scientifically useful. It will be stored on magnetic tape, microfilm and hard copy, but will not be available until 1974. For more detail see the Canadian Data Summaries included in the Technical Plan (Volume 4, pp. 37-66).

The first level of data will be a catalogue listing what data is available and in what form. It will also provide access to both the summarized data level and the main data bank.

It is hoped that this method of storage will serve the needs of all data users.

Figure 15. The largest vessel of the research fleet of CCIW, the MV Martin Karlsen, is used for year-round operation. Designed for Arctic and Antarctic exploration, 220 ft. long with a displacement of 1890 tons, she was equipped for steaming through heavy ice.

Support Groups

In both Canada and the U. S. support groups have been established for data management, technical operations, navigation and ships, publications, and public information. The people in charge of each of these are given below, together with their addresses.

Technical Operations	H. B. Macdonald, Canada Centre for Inland Waters, Burlington, Ontario.
Data Management	M. Francis, Canada Centre for Inland Waters, Burlington, Ontario.
Navigation and Ships	T. D. W. McCulloch, Marine Sciences Branch, Canada Centre for Inland Waters, Burlington, Ontario.
Public Information	A. R. Kirby, Public Relations Unit, Canada Centre for Inland Waters, Burlington, Ontario.
Publications	I. C. Brown, Secretary, Canadian National Committee for IHD, Rm. G-31, No. 8 Temporary Building, Ottawa, Ont., K1A OH3.

The projects come under six main programs, each supervised by a panel of scientists, as follows: (1) Biology-Chemistry, (2) Boundary Layer, (3) Energy Balance, (4) Lake Meteorology and Evaporation, (5) Terrestrial Water Budget, (6) Water Movement. The projects are briefly described below according to program, and with the initials of the principal laboratories that are carrying them out, and the scientist responsible for each project. In some cases, sub-programs are included in the following brief descriptions. The project numbers were assigned as the projects arrived and are not used again if a project is withdrawn.

Biology-Chemistry

81. To measure the quantity of algae-producing nutrients and toxic chemicals flowing into and out of the lake from Canadian rivers, sewage treatment plants and industrial plants. (OWRC in co-operation with WSC, S. Salbach)

82) To study the load distribution and turnover time of plankton in the
98) lake. This group of projects comprises the following related studies:
99) The vertical distribution of chlorophyll a and particles; the
100) patchiness, diurnal vertical migration and horizontal transport of
101) zooplankton, the food uptake rates and energy utilization of herbi-
102) verous zooplankton; the elementary composition of plankton and total
104) seston; the measurement of primary production and comparison of various methods of measurement; the measurement of short-term variations of phytoplankton pigments; and to measure the atmospheric chemical input to the lake from rain and dust fall. (N. Watson, G. Carpenter, W. Glooschenko, M. T. Shiomi, CCIW)

86. To study the temporal and horizontal distribution of chlorophyll a and particles along with selected physical and chemical parameters, particularly temperature. (H. F. Nicholson, CCIW)

83. To establish the size, stock and distribution of various fish types, and study the food (and pollutant) pathways from one species to the other. (W. J. Christie, ODLF)

84. To survey the extent of Cladophora growth by means of overflights and ground parties. (J. Neil, CCRS/OWRC)

85. To investigate nutrient chemical cycles at various sampling depths and stations in conjunction with eight cruises planned for the Field Year. (M. T. Shiomi, CCIW)

54. To sample the water of Deadman Bay, near Kingston, and of influent streams, to see what the geochemistry of the bay is, how it is influenced by the inflow and what seasonal variations occur. (W. A. Gorman, Queen's University)

103. To study the degree of pesticide concentration that has moved through the food chain to birds' eggs in lake bird colonies. (M. Gilbertson, CWS)

105. To look at species distribution and relative abundance of larvae fishes in Lake Ontario. (D. J. Faber, NM)

Boundary Layer

5. To measure heat, moisture and momentum transfer where air and water meet; at offshore locations at Niagara and the lake-wide meteorological buoy system. (M. Donelan, CCIW)

15. To measure the meteorological parameters of wind, temperature and humidity from aircraft flying along the lake, and compare these with tower measurements and surface observations. (E. G. Morrissey, AES)

29. To obtain data on wind, speed, direction, temperature and pressure over the lake network, and find the relationships between these variables. (F. B. Muller/C. D. Holtz, AES)

41. To investigate heat and moisture transfer between the surface boundary layer and the circulation at heights up to 1 km, using smoke trails from rockets. (D. R. Hay, University of Western Ontario)

44. To calculate, from meteorological buoy measurements, the time and space averaged measurements of fluxes of sensible heat, latent heat and momentum, and compare with other methods of measurement. (F. C. Elder, CCIW)

75. To measure wind and temperature fluctuations at Niagara Bar, using various instruments and comparing the results. (S. D. Smith, AOL)

77. To determine the atmospheric heat and water budget of the lake and basin, using sensors on aircraft platforms. (R. M. Holmes, HS)

97. To operate meteorological measurement systems on a buoy network, and process data for the data bank. (F. C. Elder, CCIW)

106. To investigate the structure of the wind, temperature and humidity fields over Lake Ontario using tethered balloon systems. (G. A. McBean, AES; M. Miyake, University of British Columbia)

107. To provide an estimate of downward transport of air pollutants from the air into the water. (D. M. Whelpdale, R. W. Shaw, AES)

Energy Balance

1. To study the main thermal features and their effects on large-scale water circulation, using remote sensors. (K. P. B. Thomson, CCRS and CCIW)

8. To co-ordinate water temperature measurements with meteorological and water-level measurements at nearly the same locations on Lake Ontario. (D. G. Robertson, CCIW)

32. To study the thermal bar and its development, and examine vertical circulation and temperature-depth profiles around the thermal bar. (G. K. Rodgers, University of Toronto)

36. To build and test an electronic bathythermograph for the measurement of a continuous temperature-depth profile. (G. K. Rodgers, University of Toronto)

42. To collect temperature profiles from ship surveys and compute the amount of heat stored in the lake in order to describe the energy fluxes. (F. M. Boyce, CCIW)

44. To measure air temperature, wind speed and direction, relative humidity and water temperature at 11 Canadian buoy stations, supplemented by 10 U. S. stations. (F. C. Elder, CCIW)

51. To measure at locations in southern Ontario the evapotranspiration rates, with approximate surface temperatures and vapour pressures. (J. A. Davies, McMaster University)

63. To observe visually during airborne ice reconnaissance, and issue charts of the distribution of ice by type and percentage cover. (T. B. Kilpatrick, AES)

71. To establish and maintain a radiation network for the Energy Budget program, with measurements made over land surfaces. (R. J. Latimer, AES)

72. To investigate the formation and growth of primary and secondary ice, ice thickness and the mechanical properties of ice, by sampling in Kingston-Oswego area. (R. O. Ramseier, HS)

73. To measure the rate at which heat flows between the lake and the sediments beneath, using oceanic heat flow techniques. (A. Judge, EP)

80. To undertake a study of the radiation balance, including radiation flux, balance components, procedures for computing radiation, production of radiation climatology and evaluation of radiation flux attenuation. (J. A. Davies, McMaster University)

87. To study the energy balance of the lake by estimating the heat advected to and from the lake by tributaries and outlets, in conjunction with stream flow data and also data on the quantities of heat entering the lake from the main power stations (Hearn, Lakeview and Pickering). (F. M. Boyce, CCIW)

88. To develop instrumentation and techniques for measuring the lake thermal structure, and for processing and interpreting these measurements. (F. M. Boyce, CCIW)

Lake Meteorology and Evaporation

16. To make weekly airborne radiation thermometer surveys over the lake, and issue maps showing the isotherms of surface-water temperatures. (J. G. Irbe, AES)

19. To conduct rawinsonde flights from three shoreline locations on both the Canadian and U. S. sides, assisted by atmospheric water balance feasibility studies. (A. M. Miceli, AES)

66. To estimate atmospheric moisture storage and moisture divergence, using rawinsonde, aircraft and surface observations, and estimate evaporation. (H. L. Ferguson, AES)

20. To measure wind, temperature and humidity at three levels, also pressure, precipitation and water temperature, and observe incoming radiation, using stable Bedford-type buoys at three locations. (J. A. W. McCulloch, AES)

21. To install, operate and maintain facilities for observing and recording air temperature; humidity, pressure, wind and precipitation at six shoreline sites. (J. A. W. McCulloch, AES)

22. To study synoptically the various meteorological events over and around the lake in order to learn about the weather systems generated by the lake, such as fog, lake effects, snow, etc.. (J. A. W. McCulloch, AES)

23. To use precipitation observations from all sources, including radar, in obtaining the distribution of precipitation in time and space during the Field Year. (D. M. Pollock, AES)

24. To study the effects of the lake on the basin's climate, using additional data from core networks. (D. W. Phillips, AES)

25. To estimate the evaporation for the whole lake, using the mass transfer technique. (J. G. Irbe, AES)

26. To re-examine, with additional data, previous work on ratios of over-lake to over-land wind, and over-lake surface humidity to that of over-land. (M. S. Webb, AES)

27. To employ an array of long-duration precipitation recorders established between Pt. Petre, Ont., and Stony Point, N. Y., and observe other meteorological parameters at Galloo Island and Pt. Petre, in co-operation with the U. S.. (J. A. W. McCulloch, AES)

62. To estimate evaporation from the lake, using terrestrial water budget, energy balance, mass transfer, pan studies, atmospheric water budget and micrometeorology. (T. L. Richards, AES)

64. To carry out monthly analyses of potential and actual evapotranspiration from climatological data, complemented by the new networks. (H. L. Ferguson, AES)

65. To establish a network of evaporation pans (U. S. provided) around the lakeshore, and use data from this and standard meteorological data in calculating evaporation and other aspects of energy balance. (J. A. W. McCulloch, AES)

67. To abstract data from aerial reconnaissance surveys for an array of grid points, and from monthly mean isotherms of surface-water temperatures. (M. S. Webb, AES)

Terrestrial Water Budget

11. To assemble monthly mean values of various parameters of the climate and hydrology of the land basin related to water balance, and compute evaporation, precipitation, run-off, moisture excess and basin storage change in relation to other data. (D. F. Witherspoon, GLSL)

12. To co-ordinate and compute estimates of various elements of the lake water balance. (D. F. Witherspoon, GLSL)

13. To determine groundwater flow in the lake on the Canadian side including the recharge, transmission and discharge characteristics of groundwater. This work is now completed; one report is issued and the second is in preparation. (H. Ryckborst, HS/OWRC)

14. To collect and reduce stream flow data of lake drainage. (B. E. Russell, WSC)

38. To determine the groundwater contribution to the lake by selected areas, and extrapolate the results to estimate the total contribution. (R. C. Ostry, OWRC)

46. To determine flow in the St. Lawrence River. (B. E. Russell, WSC)

47. To continue present research into the mathematical modelling of rainfall discharge data for the Rouge River basin, and into factors influencing water consumption in Metropolitan Toronto. (L. E. Jones, University of Toronto)

49. To study snow stratigraphy and distribution in a 500-acre property three miles north of Peterborough, and study the time profile at one site. (W. P. Adams, Trent University)

69. To prepare a pleistocene map of the basin with inserts to show its glacial history. (E. P. Henderson, CCIW/GSC)

74. To gather and process water-level and related data along the Canadian side of the lake. (G. C. Dohler, MS)

78. To estimate by various methods the monthly terrestrial water balance during the Field Year. (M. Sanderson, University of Windsor)

108. To correlate the effects of wind, differentials in barometric pressure, tides, and water and air temperature quantitatively with differences in lake levels at various points on the lake. (G. C. Dohler, MS)

Water Movement

34. To describe near-shore water circulations on the Toronto waterfront; work is completed, but may be extended to another location. (G. K. Rodgers, University of Toronto)

40. To study coastal currents by measuring currents and temperatures in two nine-mile sections by the flag-chain technique at Oshawa and Pt. Petre. (G. T. Csanady, University of Waterloo)

43. To collect temperature profile information in order to study long and short internal wave activity. (F. M. Boyce, CCIW)

45. To establish climatological and statistical characteristics of currents with self-recording current meters. (E. B. Bennett, CCIW)

76. To obtain data on the climatological aspects of wave motion through three recording stations in the lake. (G. L. Holland, MS)

89. To determine large-scale diffusion parameters and evolve a generalized diffusion law, using fluorescent dye patches followed by aerial photography and fluorometric sampling. (C. R. Murthy, CCIW)

90. To establish a climatology of coastal currents of the Great Lakes by measuring the currents and simultaneously measuring the vertical temperature profile and meteorological data. (C. R. Murthy, CCIW)

95. To develop and test multi-level numerical models of Lake Ontario and Lake Huron in order to examine hydrodynamic and thermodynamic processes. (J. Simons, CCIW)

96. To monitor water currents and temperature simultaneously at locations throughout the lake with current meter moorings at four depths, in conjunction with similar measurements by the U. S.. (E. B. Bennett, CCIW)

109. To provide detailed information on thermal structure during periods of upwelling along the northwest portion of Lake Ontario. (G. K. Rodgers, University of Toronto)

110. To determine the temperature and current climatology relevant to water intake pipe locations of proposed Ontario Hydro generating stations. (A. Arajs, Ontario Hydro)

111. To obtain continuous current records simultaneously from several current meters in the nearshore region off Lakeview in order to determine dispersion characteristics as a function of time. (M. D. Palmer, OWRC)

Additional Projects

70. To obtain surface observations of time-dependent data from the western end of the lake and the land part of the basin. (A. Falconer, University of Guelph)

93. To analyze ERTS A and SKYLAB data in terms of limnological studies; this is an application of satellite (remote sensing) data to limnological research and water management. (K. P. B. Thomson, CCIW)

94. To measure lake parameters in a remote or hostile environment and relay data in real time via satellite, using buoys with sensors, and a monitor receiver, and also collecting data via the U. S. GOES satellite at a later stage. (H. MacPhail, CCIW)

HINTS TO AUTHORS

As part of the IFYGL publications program a joint Canadian - U. S. Bulletin is being produced on a regular basis. Future issues will be joint with Canadian material edited in Canada.

To capture the most up to the minute picture we would prefer first hand accounts from those closest to the program. Some of you have been good enough to offer contributions and we take this opportunity to solicit more.

So that publication time will be kept to a minimum could we have your contribution in the following format:

(1) text -- preferably typed double spaced but if it is not possible to have this done neat handwriting is acceptable;

(2) tables -- same as for the text keeping in mind that they will have to fit either horizontally or vertically on a $6\frac{1}{2}$" x $8\frac{3}{4}$" page;

(3) figures -- in order to meet our standard format we would prefer that you send original figures, drawn on white bond or drafting paper using India ink. They should be $6\frac{1}{2}$" x $8\frac{3}{4}$" in size with lettering approximately $\frac{1}{4}$" high to allow for easy reproduction. Maps should have a frame, and latitude and longitude marked by ticks along the edges only, not drawn across the face of the map. A line scale in metric units should be included in all maps and diagrams of equipment. However, if this is not possible we do have the facilities for redrawing figures, but, as this takes considerable time we would need your contribution earlier to meet publication deadlines.

The preferred system of units is known as the Système International d' Unités, abbreviated SI. When other units are used authors are requested to give the equivalent SI units in parentheses. The main features of SI are:

(1) There are six basic units only: METRE, KILOGRAMME, SECOND, AMPERE, DEGREE KELVIN (K), and CANDELLA;

(2) The unit of force is the NEWTON;

(3) The unit of energy in all its forms is the JOULE (NEWTON x METRE);

(4) The unit of power in all forms is the WATT (JOULE/SEC.), superseding the variously defined calories, etc.;

(5) Multiples, or fractions, of units are normally restricted to steps of one thousand, or steps of one thousandth -- compound prefixes are not used (e. g. nano metre is used instead of millimicron).

Further information is provided in U. S. Department of Commerce NBS Publication 304 and 304 A, The Modernised Metric System. Many conversion factors are given in P. Anderton and P. H. Bigg, Changing to the Metric System , 3rd edition; NPL London, H. M. Stationery Office 1969.

J. MacDowall,
Canadian Editor, IFYGL Centre,
Canada Centre for Inland Waters.